

TITLE
SEPARATED SANITARY AND STORM SEWER SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

5 This application is a continuation-in-part of the co-pending U.S. patent application serial no. 10/247,430, filed September 19, 2002, which application claims the benefit of U.S. provisional patent application serial no. 60/401,714, filed August 7, 2002.

BACKGROUND OF THE INVENTION

10 The present invention relates generally to an apparatus and a method for separating sanitary effluent from storm water and/or infiltrated water in a municipal sewer system.

 Municipal sewer systems include a web of pipes that convey wastewater from homes, businesses and industries and storm water from drains to treatment plants. The
15 smallest pipes, typically twelve inches in diameter or less, are know as "collectors" that are connected to service lines running to the sanitary plumbing of buildings. The collectors are connected to "trunk lines", typically larger than twelve inches in diameter, and carrying one to ten million gallons per day. The trunk lines connect to "interceptors" that carry the wastewater to a treatment plant. The interceptors are of large diameter,
20 often more than ten feet.

 The wastewater plumbing system in a typical house, office building or manufacturing facility combines toilet effluent with other wastewater, such as from sink and bath drains, to be carried by a single service line to the collector line at the street. Hereinafter, such combined wastewater will be termed "sanitary effluent". Some
25 municipal sewer systems combine and carry in the same pipes the sanitary effluent from buildings, storm water from outside drains and any ground water leaking into the system (infiltrated water). Other municipal systems combine and carry in the same lines sanitary effluent from buildings, infiltrated water, and water from downspouts and/or footing drains, while having a separate storm drain system, but which in any case the two
30 systems are interconnected downstream. When the treatment plant and the associated web of pipes are built, the system is sized to process a predetermined number of gallons per unit of time, the maximum flow capacity, including a certain rainfall amount. As

additional buildings are connected to the system, less of the predetermined flow capacity is available for storm water. Thus, the system becomes susceptible to rainfall amounts less than the planned certain rainfall amount causing numerous overflows into streams and lakes and backups into buildings through the service lines. Overflows also can occur
5 in systems where the storm water is carried in a separate set of pipes. Such overflows and backups cause serious environmental and health problems.

Also, some sewer systems were designed with less capacity than is required to carry typical rainfall amounts thereby always overflowing during normal rainfalls. Typically, such systems were installed before there was much concern for the effect of
10 the overflow on the environment.

However, no matter what the configuration of an existing sewer system, it either now has or will in the near future have flow capacity problems causing overflows, backups and leaks. Consequently, the local governments responsible for maintaining these sewer systems face enormous expenses to repair or replace the existing pipes and/or
15 add capacity.

SUMMARY OF THE INVENTION

The present invention concerns an apparatus and method for improving the operation of sewer systems while reducing the cost of increasing system capacity. The
20 apparatus according to the present invention includes a first set of sewer lines connected to at least one storm water drain, and/or source of infiltrated water, and/or source of sanitary effluent, and a second set of sewer lines of smaller diameter than said sewer lines of said first set connected to sources of sanitary effluent, the first and second sets of lines being separately connected to a sewerage treatment plant. The second set of sewer
25 lines has at least a portion thereof that extends inside the first set of sewer lines and the first set of sewer lines can be an existing sanitary sewer system. The apparatus can include at least one sanitary effluent process device connected to the second set of sewer lines such as a pumping station, a grinder pump or a vacuum system to assist the flow of the sanitary effluent through the second set of sewer lines. The apparatus can provide the
30 same flow volume in a smaller diameter pipe that is under pressure.

The method according to the present invention includes the steps of: a. providing a first set of sewer lines connected between at least one source of storm water, and/or

source of infiltrated water, and/or source of sanitary effluent, and at least one sewerage treatment plant; b. providing a second set of sewer lines connected between a source of sanitary effluent and the sewerage treatment plant; and c. installing at least a portion of said second set of sewer lines in said first set of sewer lines. Step b. can include
5 installing a sanitary effluent collector line spaced from a collector line of the first set of sewer lines and connecting a service line from the source of sanitary effluent to the sanitary effluent collector line. Step c. can include running the sanitary effluent collector line to a manhole associated with the collector line of the first set of sewer lines and connecting the sanitary effluent collector line to a portion of the second set of sewer lines
10 installed in the first set of sewer lines. Step c. can be performed by in situ forming of pipe included in the second set of sewer lines.

A sewer system according to the present invention reduces the size of the pipe required to carry sanitary effluent and/or increases the capacity of the sewerage treatment plant to treat sanitary effluent. Since the storm water and infiltrated water are separated
15 from the sanitary effluent, they may require little or no treatment freeing plant capacity to treat the sanitary effluent. In some cases, treatment plant expansion can be delayed or eliminated.

A combined sewer pipe apparatus according to the present invention, for conveying sanitary effluent and storm water from sources to a treatment plant, includes: a
20 larger diameter first sewer pipe adapted to carry storm water and having an interior surface; a smaller diameter second sewer pipe adapted to carry sanitary effluent and extending through the first sewer pipe adjacent the interior surface; and a fastener means attaching the second sewer pipe to the interior surface of the first sewer pipe, the fastener means including a plurality of fasteners spaced apart along a length of the second sewer
25 pipe and engaging an exterior surface of the second sewer pipe and an adhesive material attaching the fasteners to the interior surface of the first sewer pipe. The apparatus can further include a liner extending through the first sewer pipe, the second sewer pipe being positioned between the interior surface of the first sewer pipe and an exterior surface of the liner. The second sewer pipe can be formed of an HDPE material and the
30 fasteners formed of a suitable plastic that can be adhesively secured to the first sewer pipe.

DESCRIPTION OF THE DRAWINGS

The above, as well as other advantages of the present invention, will become readily apparent to those skilled in the art from the following detailed description of a preferred embodiment when considered in the light of the accompanying drawings in
5 which:

Fig. 1 is a schematic block diagram of a typical prior art sewer system;

Fig. 2 is a schematic block diagram of a sewer system in accordance with a first embodiment of the present invention;

Fig. 3 is a cross-sectional view through one of the collector lines of the system
10 shown in Fig. 2 with a nested sanitary collector line;

Fig. 4 is a schematic block diagram of a portion of the system shown in Fig. 2 with process devices added;

Fig. 5 is a schematic block diagram of a sewer system in accordance with a second embodiment of the present invention;

15 Fig. 6 is an end view of a separated sewer pipe in accordance with the present invention; and

Fig. 7 is an end view of an alternate embodiment separated sewer pipe in accordance with the present invention.

20 DESCRIPTION OF THE PREFERRED EMBODIMENTS

There is shown in Fig. 1 a typical sanitary sewer system 10 of known construction. Each one of a plurality of building sewer systems 11a through 11c collects wastewater discharged from sources in the associated building and combines that wastewater as a discharge to a sanitary sewer system. Each one of the building sewer
25 systems 11a through 11c is connected by an associated one of a plurality of service lines 12a through 12c respectively to a collector line 13a. Thus, sanitary effluent from such sources as toilets, and other wastewater such as from sink drains, tub and shower drains, clothes washer drains and floor drains are combined to flow into the collector line 13a. Also, one or more storm drains, such as a storm drain 14, can be connected to the
30 collector line 13a. The collector line 13a and collector lines 13b through 13c feeding from other areas are connected to a trunk line 15a. In a similar manner, other service lines, storm drains and collector lines are connected to trunk lines 15b and 15c. The

trunk lines **15a** through **15c** are connected to an interceptor line **16a** leading to a sewerage treatment plant **17** that is connected to other interceptor lines **16b** and **16c**. Thus, wastewater, including sanitary effluent and storm water combined, flows through the collector lines, the trunk lines and the interceptor lines in a typical sanitary sewer system **10**.

While the prior art sewer system **10** is adequate for most conditions, a heavy rain entering the storm drain **14** can cause a problem by exceeding the capacity of the system to carry all of the entering water to the treatment plant **17**. Overflow relief devices **18** are provided to release the wastewater from the system into drainage ditches, ponds, rivers and lakes. Although the overflow devices **18** are shown at the junction of the collector lines with the trunk line and the junction of the trunk lines with the interceptor line, the overflow devices can be connected at any suitable points in the sewerage system. A sewerage system operating near capacity may have frequent overflow problems causing contamination of swimming and boating areas with fecal matter and other wastes. Also, exceeding the system capacity causes backup through the service lines **12a** through **12c** typically flooding buildings with the combined sanitary effluent and storm water. The present invention seeks to solve the overflow and backup problem and increase the water treatment capacity of the sewer system by separating the sanitary effluent from the storm water as both flow through the system.

There is shown in Fig. 2 a first embodiment sanitary sewer system **20** according to the present invention wherein the sanitary effluent is completely separated from the remainder of the building wastewater. As also shown in Fig. 1, each of the building sewer systems **11a** through **11c** is connected by an associated one of the plurality of service lines **12a** through **12c** respectively to the collector line **13a**. Thus, wastewater from such sources as sink drains, tub and shower drains, clothes washer drains and floor drains is combined to flow into the collector line **13a**. However, the sanitary effluent from the toilets is connected to each of a plurality of sanitary effluent service lines **22a** through **22c** to carry the sanitary effluent to a sanitary effluent collector line **23a** separate from the original collector line **13a**. While new construction can be built with the required separated plumbing, existing building would require conversion. As an alternative, the new service lines **22a** through **22c** could be connected to and the old service lines **12a** through **12c** disconnected from the existing plumbing. Sanitary effluent

collector lines **23a** through **23c** are connected to a sanitary effluent trunk line **25a** that is connected to a sanitary effluent interceptor line **26a** with other sanitary effluent trunk lines **25b** and **25c**. The sanitary effluent lines **23a** through **23c**, **25a** through **25c**, and **26a** are interconnected at connectors **28** that do not require overflow protection. Thus, the
5 sanitary effluent is separated from the other wastewater and will not overflow or back up into the buildings when storm water overloads the system **20**.

Although the sanitary effluent lines **22a** through **22c**, **23a** through **23c**, **25a** through **25c** and **26a** could be run parallel to the other lines **12a** through **12c**, **13a** through **13c**, **15a** through **15c** and **16a**, it is preferred that sanitary effluent lines run inside the
10 other lines where possible to avoid digging separate trenches. Since existing sewer lines typically run through developed land, the installation of parallel lines can be extremely costly and very disruptive to homes and businesses. Thus, the existing sewer system **10** can be retrofitted with the new sanitary effluent lines. The sanitary effluent pipes will be of a smaller diameter than the corresponding pipes of the existing system **10** since the
15 volume of sanitary effluent wastewater to be carried is less and the addition of pressure increases the flow rate. Fig. 3 shows the smaller diameter sanitary effluent connector line **23a** extending inside the larger diameter collector line **13a** that now only conveys storm water. Although the line **23a** is shown spaced above a bottom of the outer line **13a**, such representation is only for the purpose of clearly illustrating two separate lines
20 and the sanitary effluent connector line **23a** typically would rest on the bottom of the connector line **13a**. Similarly, the sanitary effluent trunk line **25a** would run inside the trunk line **15a** and the sanitary effluent interceptor line **26a** would run inside the interceptor line **16a**.

In order to properly convey the sanitary effluent wastewater to the treatment plant
25 **17**, one or more process devices may be required. For example, as shown in Fig. 4, a first process device **29a** is connected between the collector line **23a** and the trunk line **25a**. A second process device **29b** is connected between the trunk line **25a** and the interceptor line **26a**. The process devices **29a** and **29b** can be pumping stations, grinder pumps, vacuum systems, or any other type of device used to assist the flow through the
30 lines of the sewer system **20**. The process devices can be inserted at any point in the sewer system **20** and different types can be used together as required.

Since the flow through the sanitary effluent lines **23a**, **25a**, and **26a** is assisted by pressure or vacuum, the flow rate is greater than in a prior art gravity system for the same diameter pipe. Thus, the cross-sectional area required to flow the same volume is reduced leaving more room in the other wastewater lines **13a** through **13c**, **15a** through **15c** and **16a** thereby increasing the capacity to carry storm water. When there is an overflow condition, the water escaping from the overflow devices **18** is not contaminated with effluent. Also, the wastewater flowing in the lines **12a** through **12c**, **13a** through **13c**, **15a** through **15c** and **16a** either does not have to be treated at the plant **17** or may require only a primary treatment. Thus, another advantage of the present invention is the freeing of significant capacity of existing plants to treat additional wastewater from the sanitary effluent lines and a reduction in the size of new treatment plants.

In some situations, it is desirable not to provide the sanitary effluent service lines **22a** through **22c** shown in Fig. 2, such as when retrofitting an existing system. There is shown in Fig. 5, a second embodiment sanitary sewer system **30** wherein the service lines **12a** through **12c** are connected to the sanitary effluent connector line **22a** that runs parallel to the collector line **13a**. Both of the collector lines **13a** and **22a** run into a manhole **31** wherein the line **22a** can be inserted into the line **13a**. From the manhole **31**, the sanitary effluent lines run inside the corresponding existing sewer lines as in the system shown in Fig. 2.

The sewer system according to the present invention can be installed as a complete new system or during the repair of an existing system wherein the existing collector, trunk and interceptor lines are used as a first set of sewer lines that are connected to a source of storm water. The sanitary effluent lines according to the present invention are a second set of smaller diameter sewer lines that can be made of any suitable material such as plastic or composition materials and these lines can be placed in sections that are connected together or formed in situ during installation. A sewer system according to the present invention will prevent, or at least reduce overflows, and will eliminate backups into buildings. A sewer system according to the present invention provides a relatively inexpensive way to solve pollution problems and to modernize and expand existing sewer systems.

There is shown in Fig. 6 a separated sewer pipe **40** according to the present invention for use in the above-described sewer systems. An existing larger diameter

combined sewer pipe **41**, typically formed of a concrete or steel material, has an interior through which a new smaller diameter sanitary sewer pipe **42** has been inserted. The new pipe **42** can be formed of, for example, a suitable HDPE (high density polyethylene) plastic material. It is desirable to fix the new pipe **42** to an interior surface **41a** of the existing outer pipe **41**. A fastener **43** is utilized for this purpose and preferably is formed from a molded plastic material or other material suitable for adhesion to the outer pipe **41**. The fastener **43** can be of continuous form, extending the length of the pipe **42**, or provided as a plurality of fastener straps spaced apart along the longitudinal axis of the pipe **42** at suitable intervals as shown in Fig. 3 being used with the collector line **23a**.
10 The fastener **43** can be free or can be attached to the outer surface of the pipe **42** by any suitable means such as adhesive or ultrasonic welding.

The fastener **43** has an arcuate central portion **44** that is curved to engage a part of an outer surface of the pipe **42**. Extending from either end of the central portion **44** is an end portion **45** that is shaped to engage a part of the inner surface **41a** of the pipe **41**.
15 The end portions **45** are attached to the pipe **41** with a suitable adhesive material **46** that adheres to both concrete and plastic and is moisture resistant. The adhesive **46** also can fill spaces **47** surrounded by the facing surfaces of the pipe **41**, the pipe **42** and the fastener **43**. One adhesive that can be used is a 3M Scotch-Grip Industrial Adhesive 4799 available from 3M Adhesives Division in St. Paul, MN. In the Continuous form,
20 the fastener **43** requires slots or apertures (not shown) formed therein for introducing the adhesive **46** between the end portions **45** and the surface **41a** and into the spaces **47**.

Although the pipe **42** is shown in Fig. 6 as being mounted at the bottom of the interior of the pipe **41**, it can be mounted at any desired point along the circumference of the inner wall **41a**. For example, in Fig. 7, the pipe **42** is shown mounted at the top of the interior of the outer pipe **41**. This mounting can be the same as is shown in Fig. 6 utilizing the hanger **43** and the adhesive material **46**. However, Fig. 7 shows a separated sewer pipe **50**, according to an alternate embodiment of the present invention for use in the above-described sewer systems. When the existing combined sewer pipe **41** has a rough interior surface **41a** and/or is cracked and leaking, it may be desirable to provide a
25 lining **51**. The lining **51** can be inserted into the interior of the existing sewer pipe **41** or can be formed in situ after the new pipe **42** is installed. The lining **51** holds the pipe **42** in place and the hangers **43** and the adhesive **46** are not required.
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Although the separated sewer pipes **40** and **50** have been discussed in terms of utilizing the existing combined sewer pipe **41**, a new storm sewer pipe can be provided where the old pipe must be replaced or in new construction installations.

As shown in Fig. 3, the fasteners **43** can be used with a grout material or an
5 adhesive material **48** applied along the entire length of the sanitary sewer pipe **23a** (**42**). Furthermore, if the grout/adhesive material alone **48** is a sufficient fastening means, the fasteners **43** can be eliminated.

In accordance with the provisions of the patent statutes, the present invention has been described in what is considered to represent its preferred embodiment. However, it
10 should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.